



# ATLAS TO EXPLORE HYDROCARBON OPPORTUNITIES IN THE DUTCH OFFSHORE

Explore in a mature basin

# Upper Jurassic Play

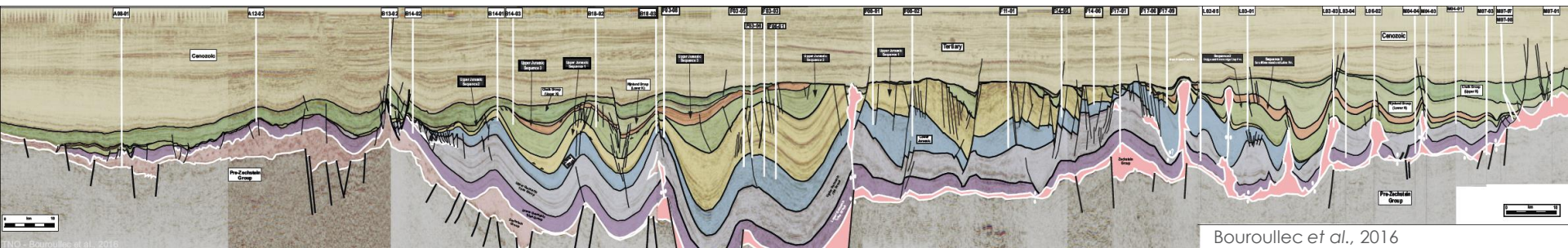


Presented by **Susanne Nelskamp (TNO)**

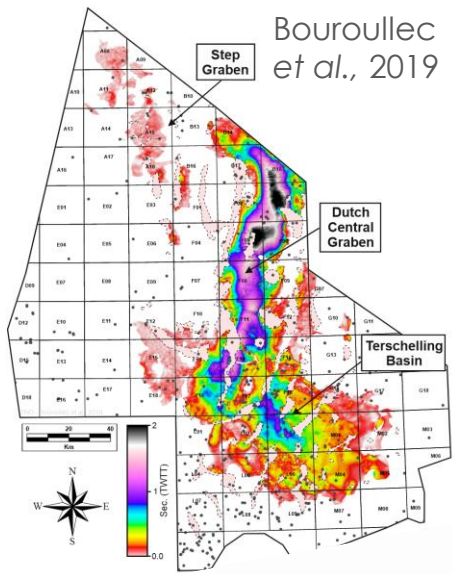
## The team

R. Bouroullec (TNO), W. Smit (EBN), S. Nelskamp (TNO), L. Hanemaaijer (EBN), M. Brussee (EBN),  
E. van Linden (TNO)

Special thanks to Roel Verreussel (TNO), Rob Lengkeek (ONE-Dyas) and Ben Kilhams (Shell)



Bouroullec  
et al., 2019



# Source Material

Recent TNO research forms the basis for this GEODE Play.

**TNO**

ebn

Several TKI research projects (JUSTER, FOCUS, COMMA, MAXIM) and publications by TNO provided most of the material for the new maps compiled in the new Atlas.

Most reports already available for download on [www.nlog.nl](http://www.nlog.nl)

**Out of confidentiality in 2022**

## FOCUS Project

Upper Jurassic Sandstones: Detailed sedimentary facies analyses, correlation and stratigraphic architectures of hydrocarbon bearing shoreface complexes in the Dutch offshore

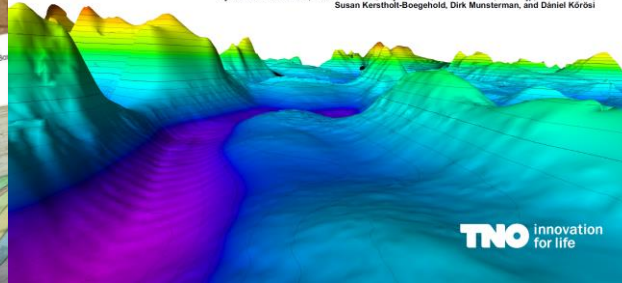
by Renaud Bouroullec, Roel Verreussel, Kees Geel, Dirk Munsterman, Geert de Bruijn, Mart Zijp, Nico Janssen, Isabel Millán and Thijs Boxem



## ComMa Project

Understanding Jurassic Sands of the Complex Margins of the Eastern Part of the Terschelling Basin during the Upper Jurassic and Lowermost Cretaceous

by Renaud Bouroullec, Roel Verreussel, Thijs Boxem, Geert de Bruijn, Mart Zijp, Nico Janssen, Susan Kerstholt-Boegehold, Dirk Munsterman, and Daniel Körösi



**TNO** innovation for life

## MAXIM Project

BASIN MARGIN-TO-AXIS: TECTONOSTRATIGRAPHY OF THE DUTCH CENTRAL GRABEN DURING THE LATE JURASSIC

by Renaud Bouroullec, Susanne Nelskamp, Stefan Peeters, Roel Verreussel, Tanya Goldberg, Geert de Bruijn, Kees Geel, Nico Janssen, Dario Ventra, Alexander Houben, Susan Kerstholt-Boegehold and Vincent Vandeweyer



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Mesozoic Resource Potential in the Southern Permian Basin . Geological Society, London, Special Publications, 469

- Bouroullec et al., 2018, Tectonostratigraphy of a rift basin affected by salt tectonics: synrift Middle Jurassic - Lower Cretaceous in the Dutch Central Graben, Terschelling Basin and neighbouring platforms, Dutch offshore. <https://doi.org/10.1144/SP469.22>
- Verreussel, et al., 2018, Stepwise basin evolution of the Middle Jurassic- Early Cretaceous rift phase in the Central Graben area of Denmark, Germany and the Netherlands. <https://doi.org/10.1144/SP469.23>

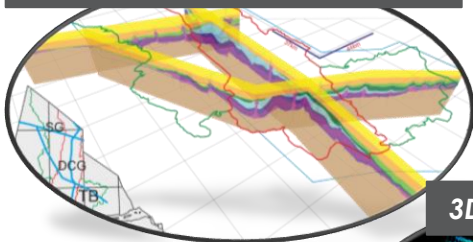


# Source Material

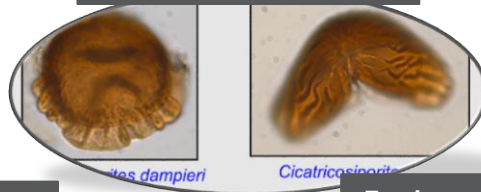
The recent multidisciplinary research established a new tectonostratigraphic framework for the Middle Jurassic to lowermost Lower Cretaceous.

- All available seismic data and 184 wells were used overall for those studies
- 17 new core descriptions, 108 new palynological analysis carried out
- 6 key seismic horizons were mapped and three PaleoScan studies (F06, B14/B18 and L02-L05 areas)
- 7 new paleogeographic maps were produced

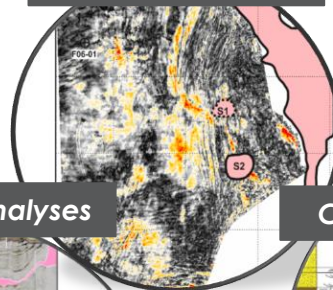
**Regional seismic interpretation**



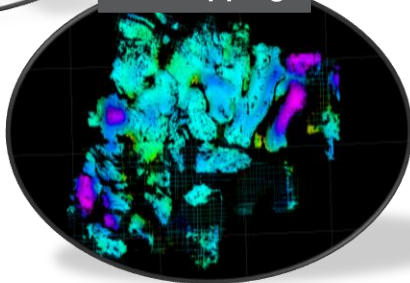
**Palynological analysis**



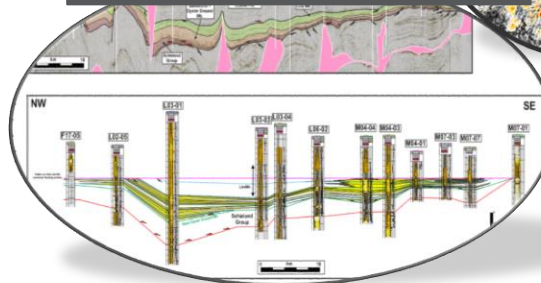
**Amplitude analysis**



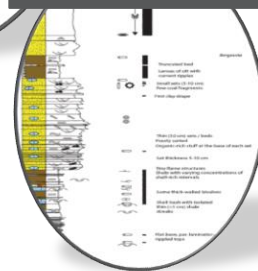
**3D mapping**



**Tectono-stratigraphic analyses**



**Core description**





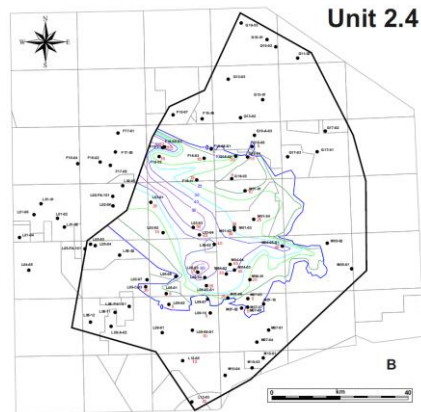
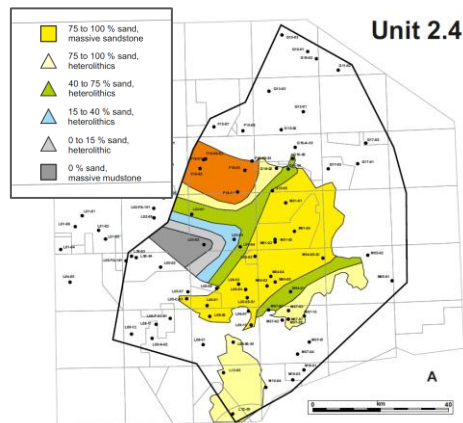
# Reservoir data

Depth and thickness maps from 2D and 3D seismic mapping

Detailed thickness and facies maps for the Terschelling Basin for three intervals

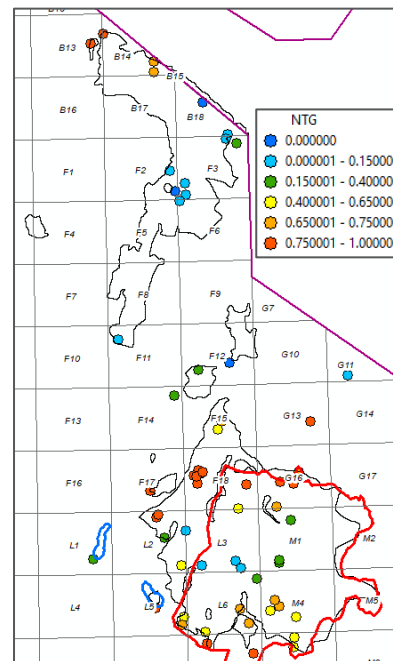
Updated log interpretation for sand presence and thickness for 69 wells

## Lithofacies maps (Comma)

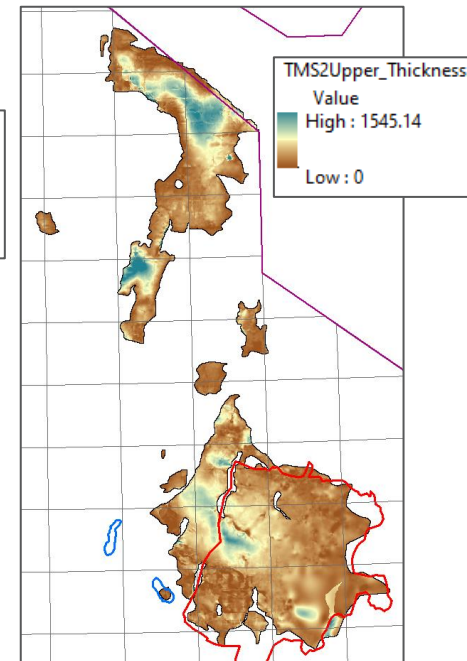


Bouroullec et al., 2016

## N/G from wells

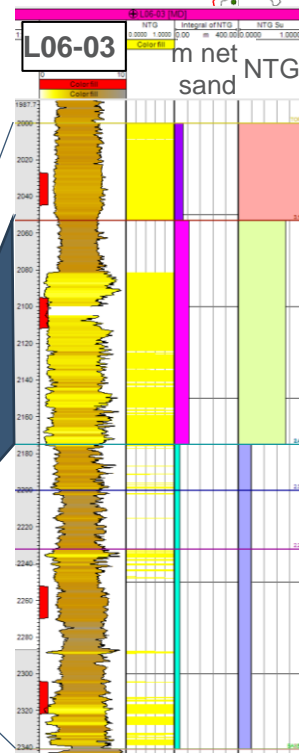
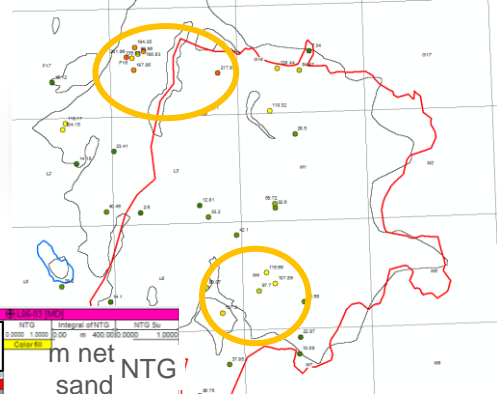
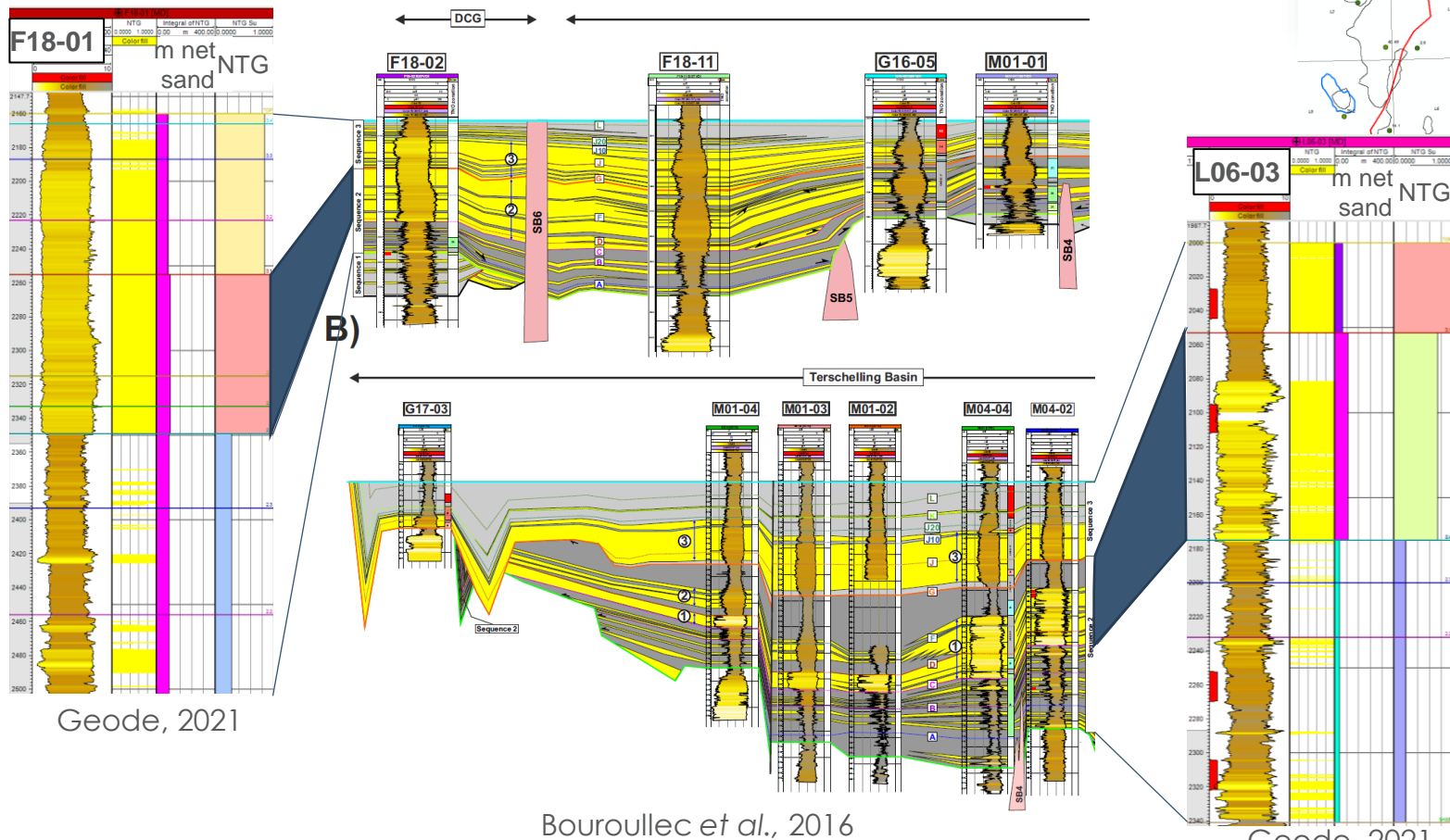


## Thickness



Geode, 2021

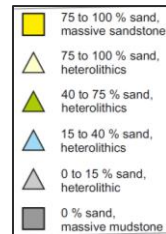
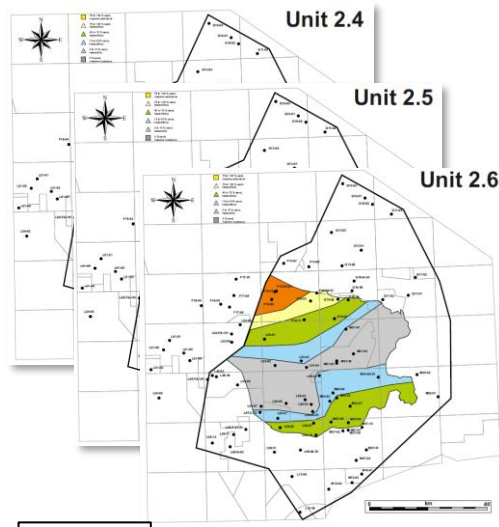
# Input data – log interpretation



# Mapping

Terschelling Basin

## Lithofacies maps (Comma)



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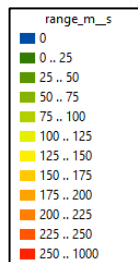
Facies maps from the COMMA project

N/G classification correlated to facies classification

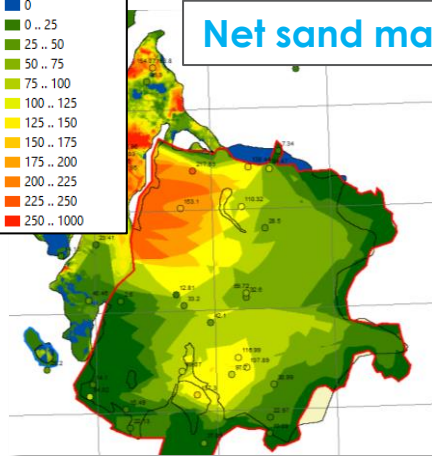
Stacking of individual maps based on thickness proportion (per subplays)

Comparison to well log interpretation (QC)

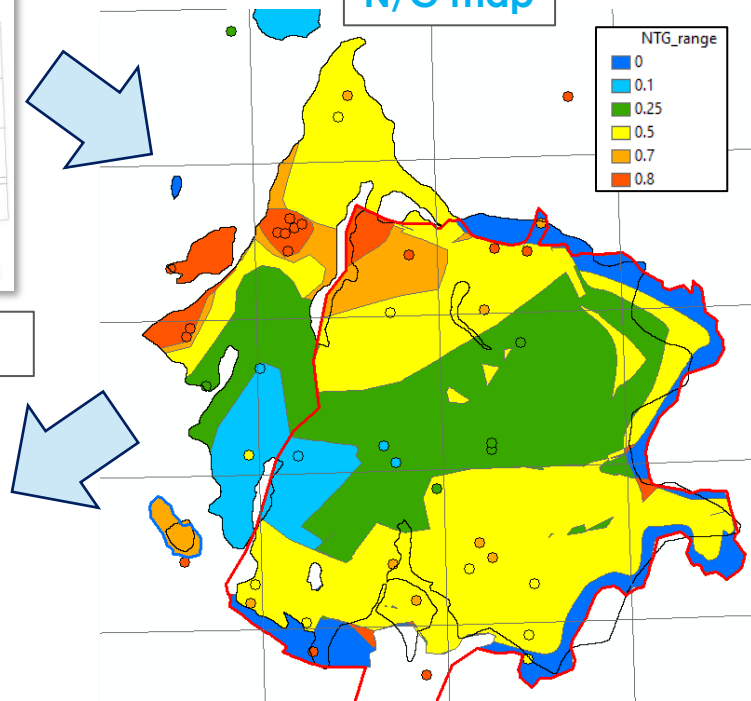
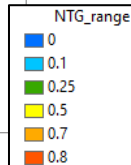
Total sand thickness based on sum of individual facies maps, multiplied by thickness of the given subplay



## Net sand map



## N/G map





# Mapping

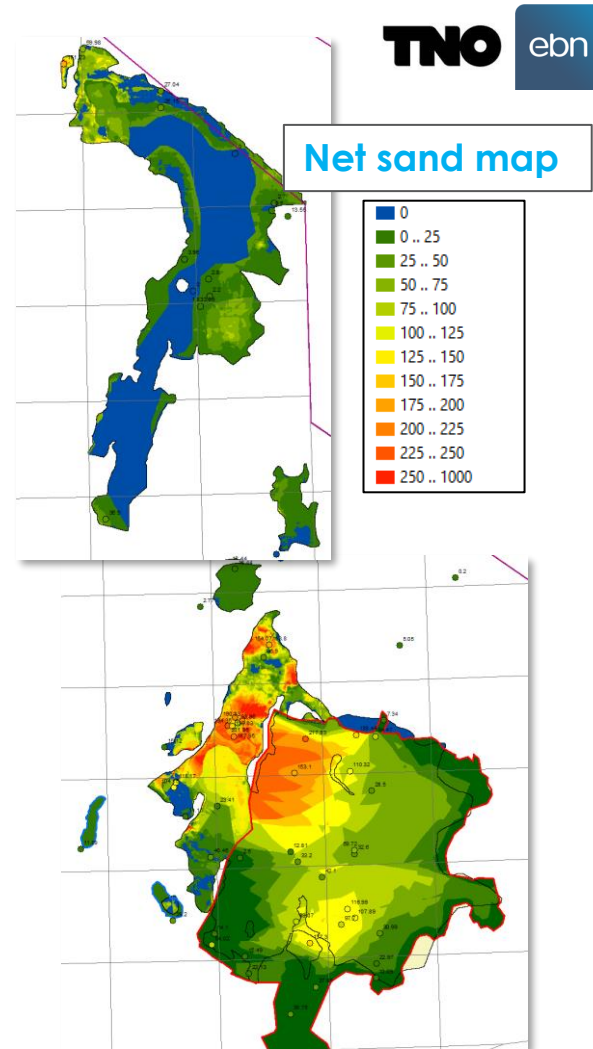
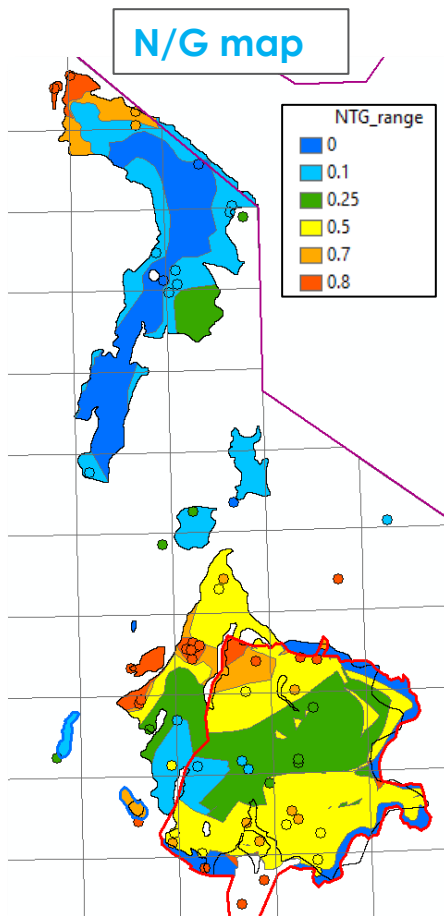
Dutch Central Graben

N/G information directedly from well log interpretation

Paleogeographic (not shown until Oct 2022), structural, thickness, and basin margin type maps used as guides for drawing polygons

Final polygons shapes checked against well data for total m sand values

Merged with the Terschelling Basin maps

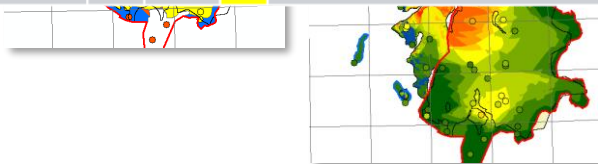


# Reservoir presence

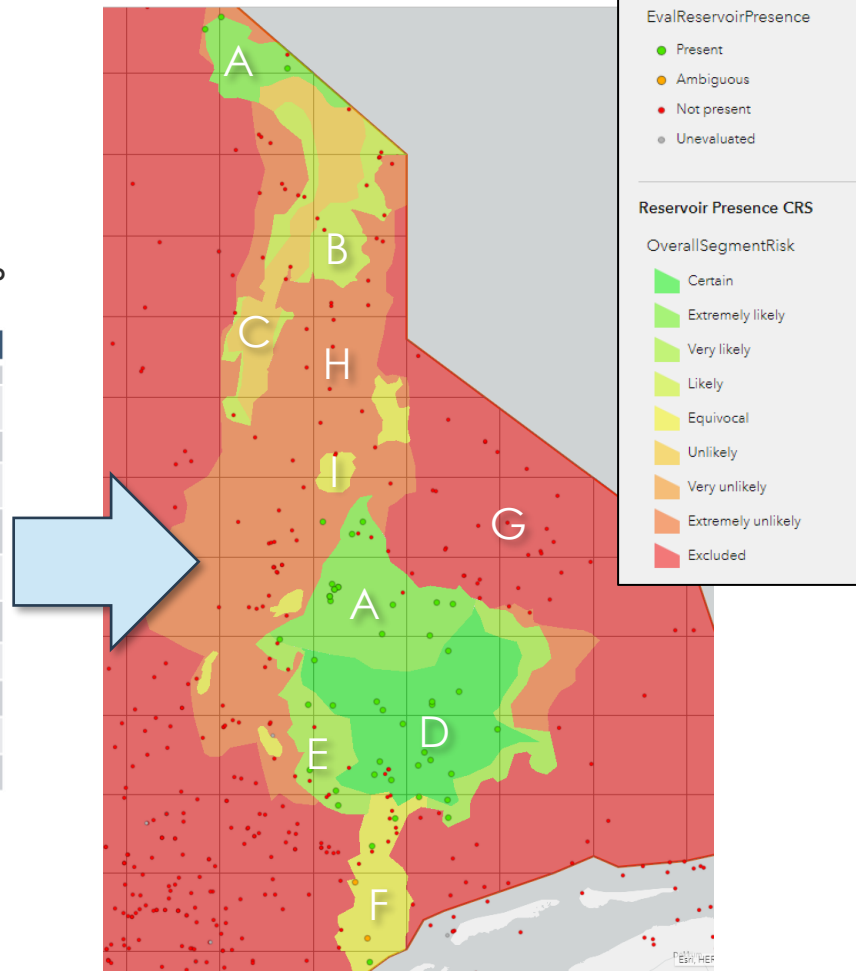
Total thickness, meters sand and N/G maps



TMS 2 Upper Reservoir Presence CRS risking				
map	Formation	Play POS	Rep. POS	Total POS
A	Noordvaarder > 25 m sand	100	90	90
B	Basin margin sands DCG	60/70	90	54/63
C	0 meter sand in net sand map	50	40	20
D	Terschelling Sandstone >25 m	100	100	100
E	Terschelling Sandstone < 25 m	100	70	70
F	Terschelling Sandstone below seismic resolution	100	50	50
G	No TMS2-upper outside DCG and TB	0	0	0
H	No TMS2-upper inside DCG and TB	50	10	5
I	TMS2-upper mapped, no well	50	100	50



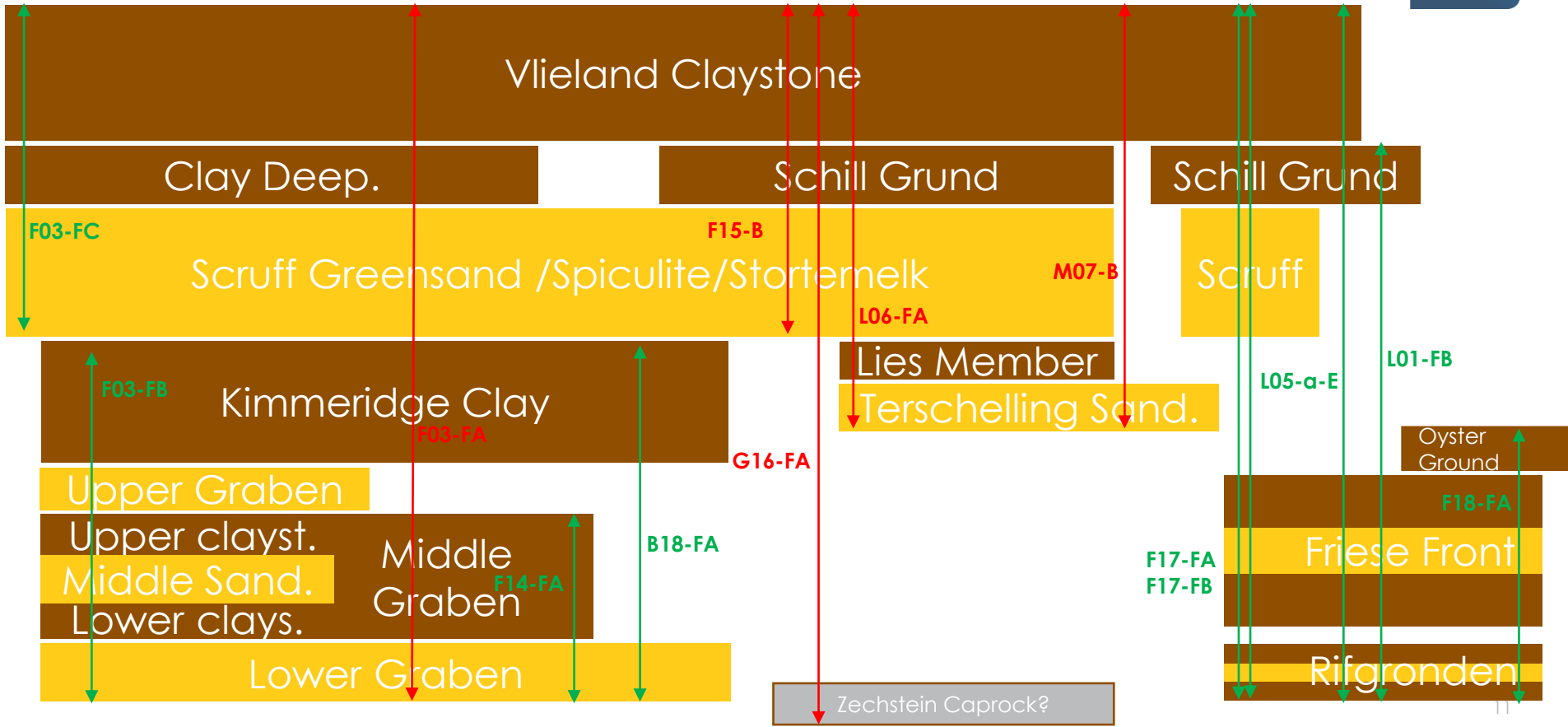
## Reservoir presence CRS



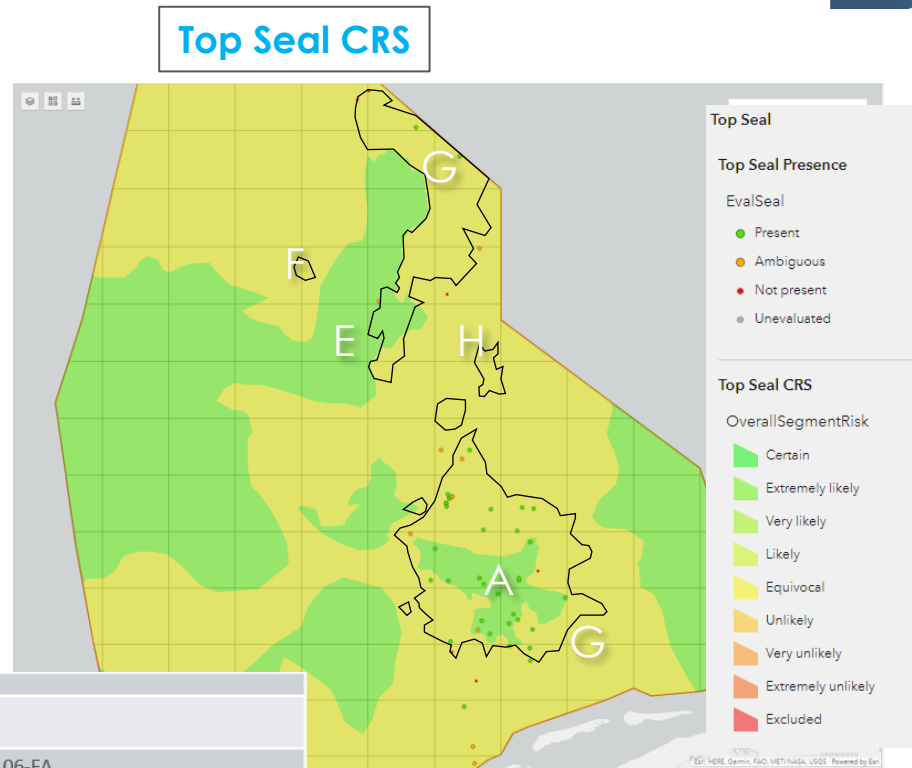
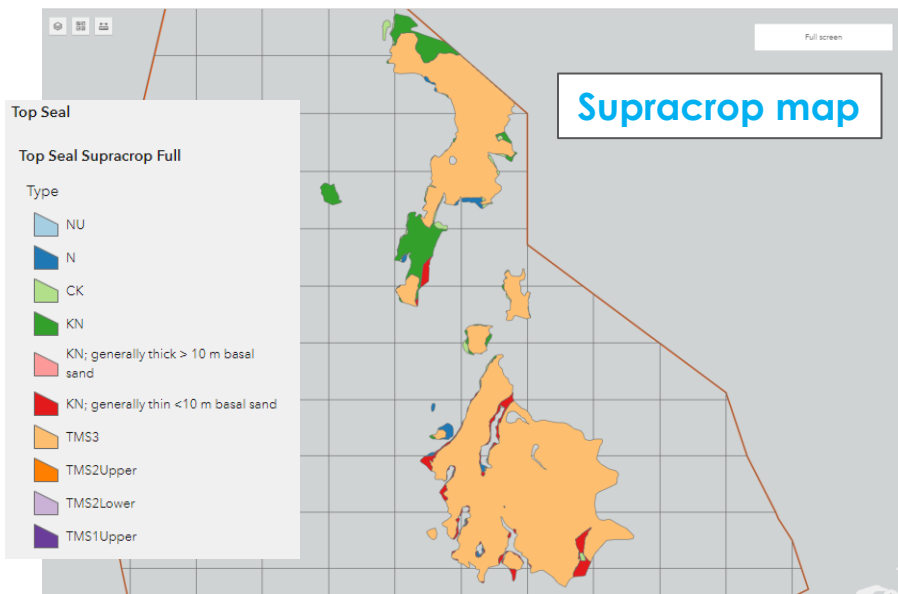
# Proven reservoir – seal pairs

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# Top Seal maps



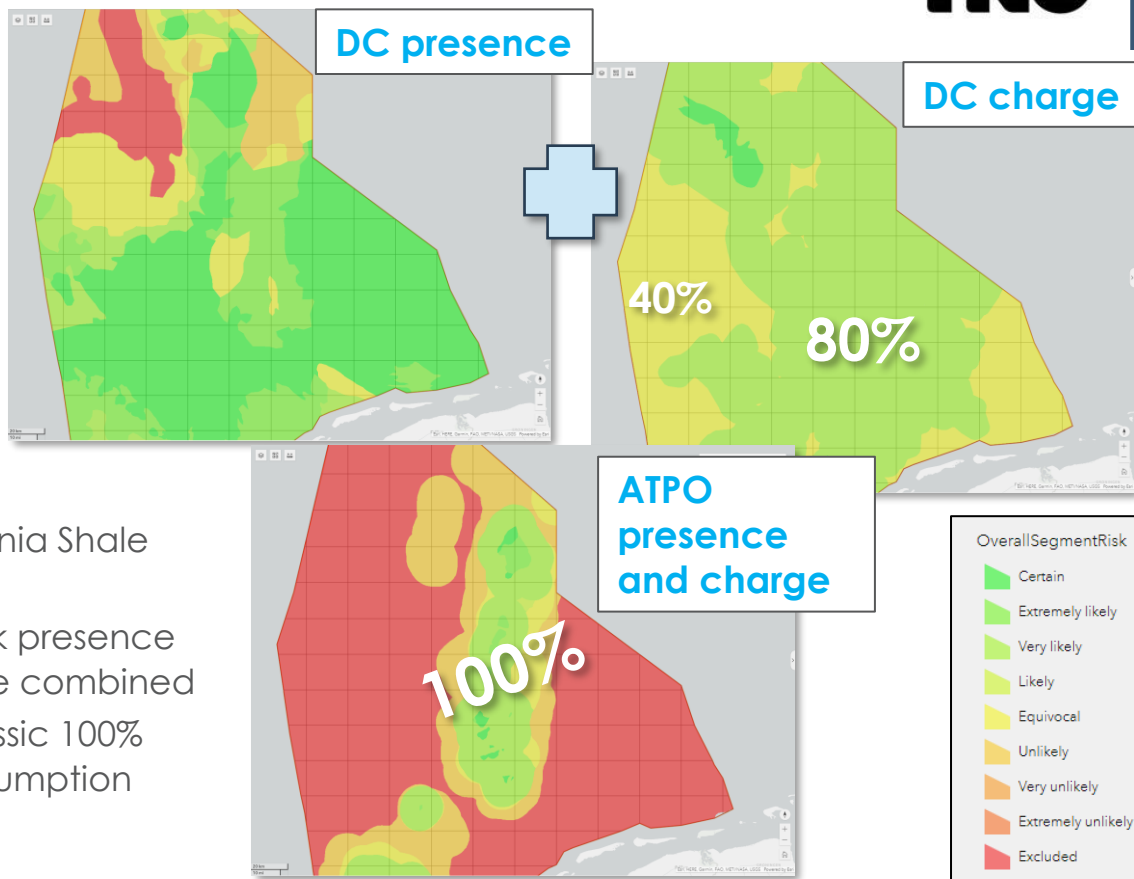
map	Formation	TMS	Play POS	Rep. POS	Total POS	Comment
A	Lies member > 50 m	1U	100	90	90	Proven seal L06-FA
E	Vlieland Claystone present and Rijnland > 50 m	KN	100	90	90	Proven seal M07-B
F	Vlieland Claystone absent (Holland Marl) or KN < 50 m	KN	80	60	48	
G	KNNS; Scruff	Var.	50	70	35	Various non seal units
H	Chalk/North Sea variable thickness generally < 50 m	N/CK	70	60	42	North Sea / Chalk unknown



# Source rock presence and charge

Carboniferous source rocks:

- Source rock presence CRS map
- Charge map based on Zechstein presence and thickness



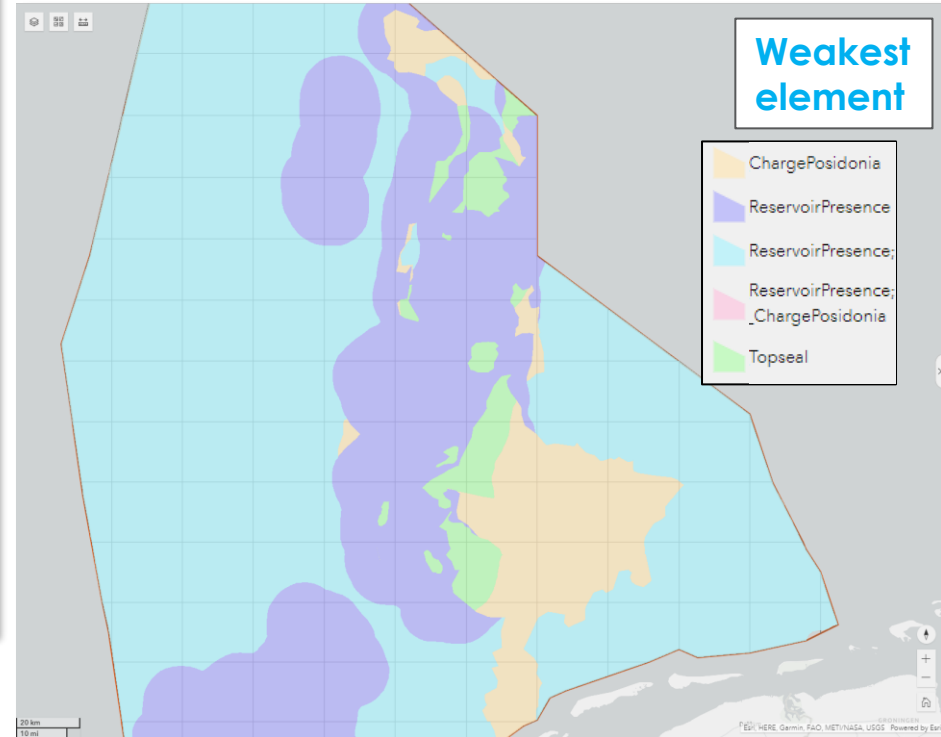
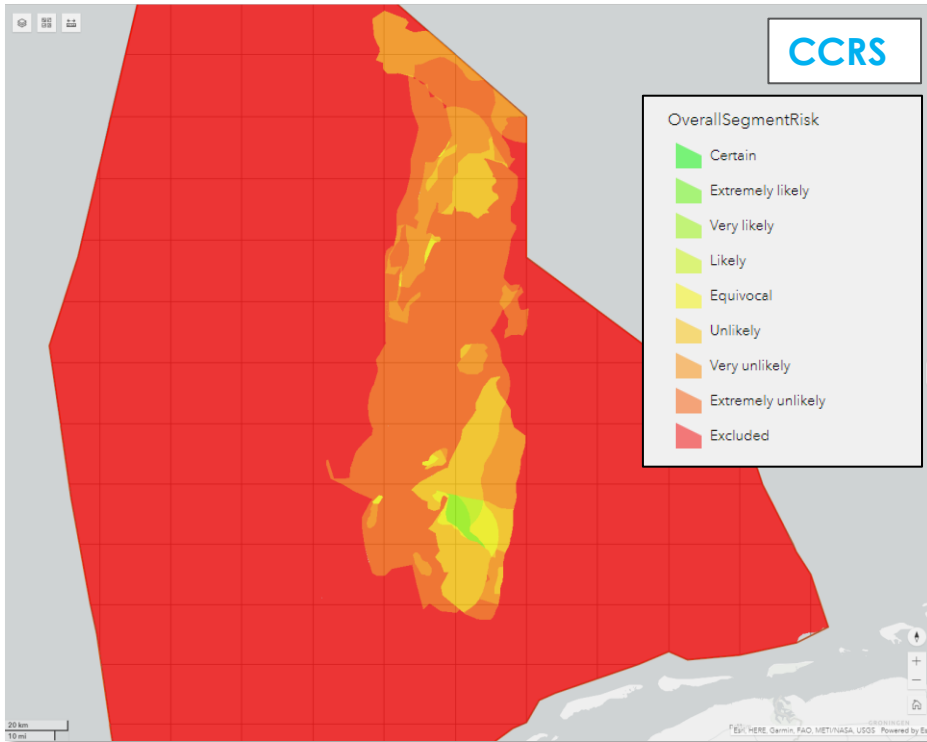
Jurassic Posidonia Shale Formation:

- Source rock presence and charge combined
- Upper Jurassic 100% charge assumption

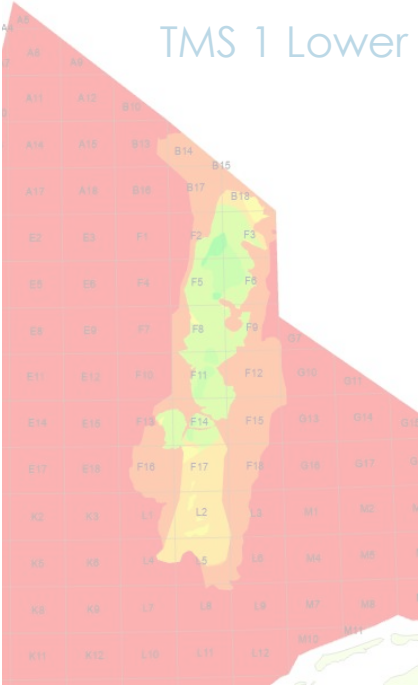
# CCRS and weakest element maps

Jurassic Posidonia Shale Formation

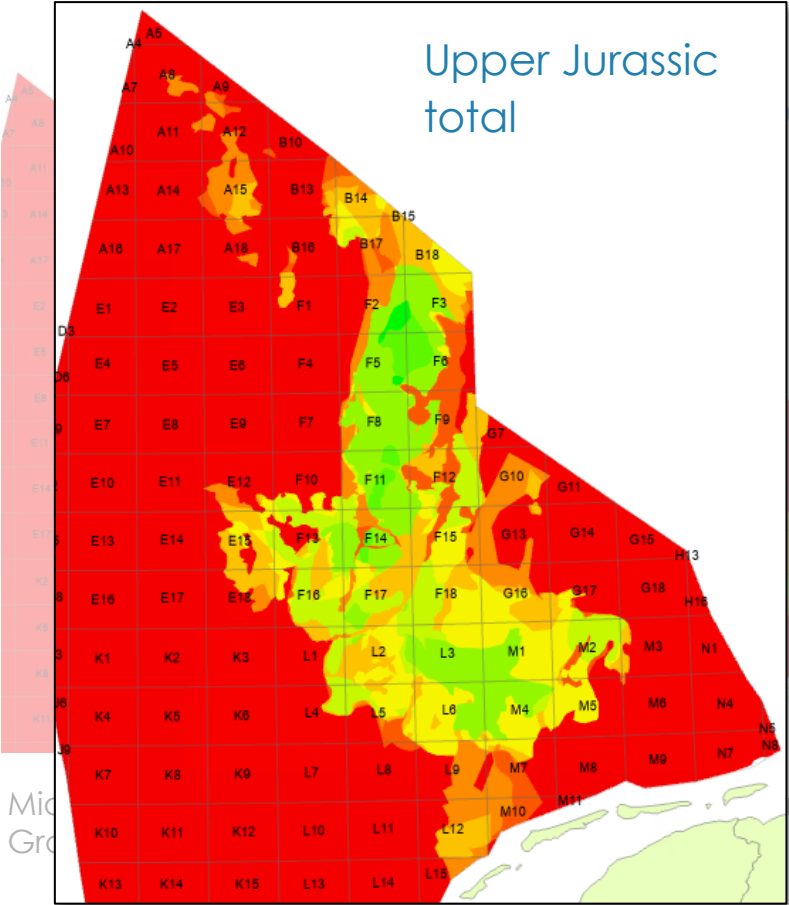
Similar maps available for the  
Carboniferous source rocks



# CCRS maps – all source rocks and sub-plays



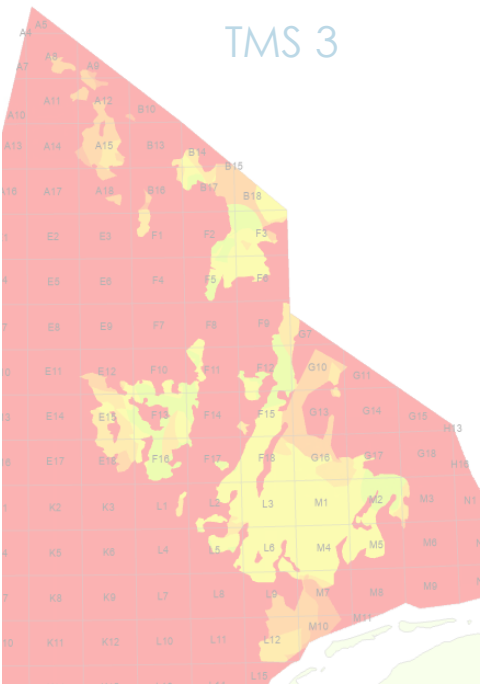
Lower Graben,  
Rifgronden



Mid  
Gro



ne,



Scruff

# Conclusions

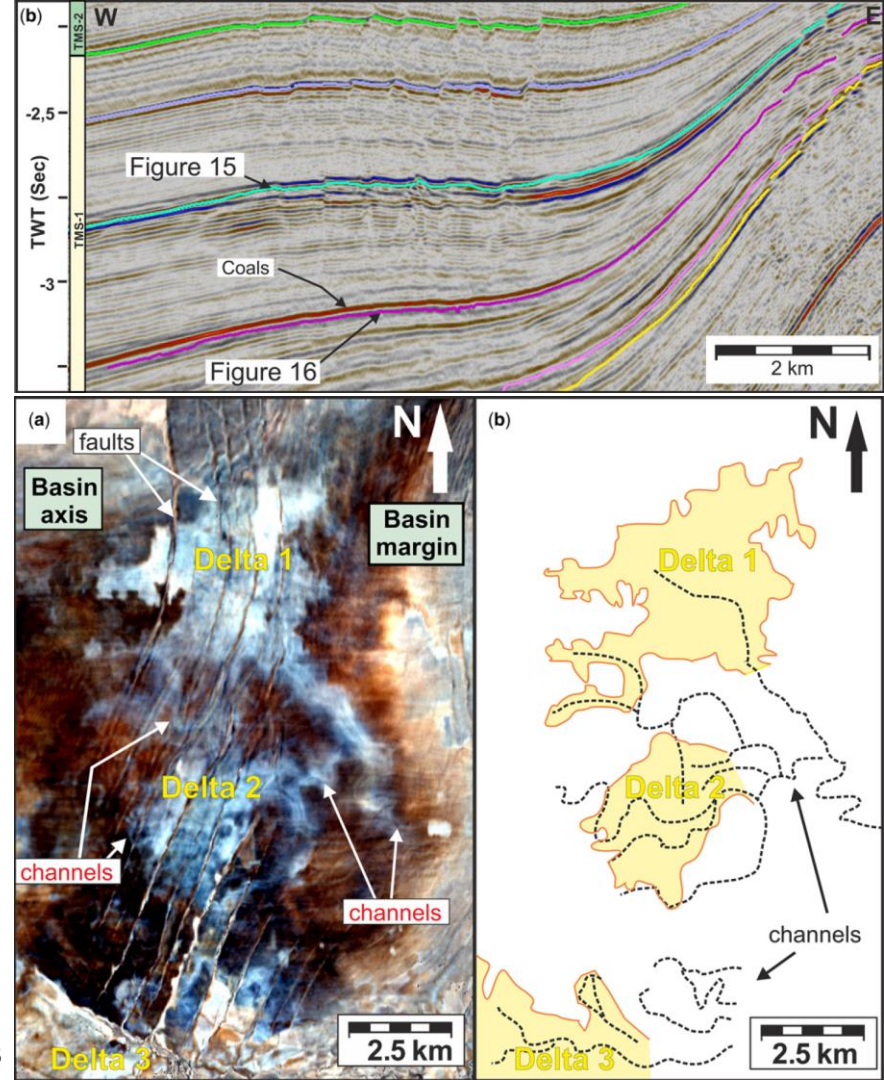
## Upper Jurassic Play

Play is proven and still contains exploration potential

Biggest risks associated with reservoir presence and seal presence

Further work:

- Update of Charge assessment from the Carboniferous including faults and results from the Triassic play assessment (Main Röt Evaporite Mb)
- Play updates using new studies to be released in 2022 and beyond.





## Explore in a mature basin

GEODE is a joint initiative between EBN B.V. and TNO. We aim to provide an easy accessible web-based GIS environment where play based exploration data, such as maps and post-drill well analysis data, for the main hydrocarbon (sub)plays of the Dutch offshore, are available and can be displayed and downloaded.

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